Determining "Ground Truth" in the New Jersey STRATAFORM Natural Laboratory

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LONG-TERM GOALS

Understand the creation of preserved stratigraphy along continental terraces, by linking sedimentation processes to preserved sequence stratigraphy and facies architecture.

OBJECTIVES

As part of STRATAFORM, the University of Texas Institute for Geophysics (UTIG) and collaborators are continuing to integrate "nested" seismic data available off New Jersey with subsurface samples of various kinds, as they become available. This primary STRATAFORM goal remains elusive off New Jersey, because "ground-truthing" of seismic sequence boundaries and intervening facies by sampling at all relevant depths is as yet incomplete. The objectives are: 1) to study the history of sea-level change over the past ~35 Ma, and 2) to determine the effects of various depositional and erosional processes on the preserved continental margin sediment record, from the seafloor to subbottom depths of ~100 m.

APPROACH

Task 1: a) integrate regional high-resolution MCS with ODP cores and downhole logs and b) correlate Huntec 2D/3D and chirp sonar control with grab samples and vibra-cores (STRATAFORM tasks C1, C4, C5)

- Finish interpreting high-resolution MCS profiles collected for STRATAFORM in 1995 in the context of Ocean Drilling Program (ODP) Leg 174A drilling results and existing MCS interpretations on the shelf and upper slope (Fulthorpe, Austin, Olson).
- Link outer shelf and upper slope stratigraphic regimes, by tying ODP Leg 174A and Leg 150 results seismically, in order to understand source-to-sink sediment dispersal systems (Fulthorpe, Austin).

Task 2: calibrate shallow subsurface seismic stratigraphy, in order to assess the preservation potential of the New Jersey shelf succession (STRATAFORM tasks C2, C4, C5, C6c)

- Ascribe physical significance to existing 2D and 3D seismic images of surficial seismic stratigraphy through analysis of core samples (Austin, Fulthorpe, Olson, Duncan).
- Investigate the apparent lack of coherence between the modern sea floor and the shallowest subsurface (Goff, Olson, Duncan).

WORK COMPLETED

Analysis and integration of results from Leg 174A, conducted in June-July 1997, are completed; at UTIG, the analysis and integration has been led by Fulthorpe with help

from Austin. The Leg 174A Scientific Results volume is available on the WWW at http://www-odp.tamu.edu/publications/.

Since UTIG collected its first 3D Huntec data on the New Jersey shelf in 1989, a primary objective has been ground-truthing resultant ultra-high resolution images. Short piston cores were acquired after the 1989 survey; a suite of vibra-cores was collected in association with the second 3D survey in 1993. A test of the *Marion Dufresne*-based CALYPSO corer took place in June 1999; shelf penetrations in the vicinity of the 1989 3D survey were either completely unsuccessful or did not greatly exceed the ~5 m vibra-cores recovered in 1993 (and this recovery may have been flow-in). Nonetheless, studies of CALYPSO cores continue (Olson).

A comprehensive geological/geophysical characterization of the uppermost middle-outer New Jersey shelf is underway, usong multi-beam backscatter/bathymetric images of the seafloor and 2D/3D ultra-high resolution geophysical control collected in accordance with **Tasks C2 and C5**. Surficial sediment (grab-) sampling efforts, along with chirp and sidescan-sonar surveys, have been led by Goff at UTIG, with support from Olson, Austin, Duncan, and others. Duncan has completed her Ph.D. on the stratigraphic relationships among Huntec 2D/3D control, chirp sonar data, and both grab samples and short (up to ~5 m) vibra-cores collected on the middle-outer shelf in 1993 (Duncan et al., 2000).

RESULTS

Isopach/structure maps of Miocene to Pleistocene shelf sequence boundaries and downlap surfaces (indicators of maximum flooding) beneath the New Jersey shelf and upper slope are beginning to illustrate the sediment distribution through time (Austin, Christie-Blick, Malone et al., 1998). Such mapping is the focus of **Task C1**, which mandated contouring thicknesses and describing facies of mid-shelf to upper slope sequences. Understanding these shelf/slope systems is the ultimate objective of **Task C4**, which mandated that "high-resolution" 2D MCS control be acquired, analyzed and interpreted across the shelf-slope break. Fulthorpe et al. (1999) have shown that rivers discharged near the paleo-shelf edge during some Miocene sea-level lowstands. However, slope canyons probably formed independently of such fluvial systems. Although such canyons did form during lowstands, their presence appears to have been controlled by local conditions (e.g., efficiency of sediment transport, rate of sediment supply, grain size, spring-sapping?) other than sea level (Fulthorpe et al., 2000).

As a result of studies completed since the first vibra-cores were collected (1993), we know that the surficial, latest Pleistocene-Holocene stratigraphy is: 1) complicated (Buck et al., 1999), and 2) not directly related to seafloor morphology (Goff and others, see **Tasks C2 and C5**, above). However, reworking does <u>not</u> extend to great depths, perhaps not more than ~0.5 m sub-sea floor. Another complexity arises from the stratigraphy associated with surficial filled, meandering channels; these have been imaged by both the 1989 and 1993 Huntec 3D surveys. Duncan et al. (2000) have developed a model relating the observed Huntec stratigraphy to depositional processes associated with the last transgression (~22-7 ka) across the New Jersey margin; this is an important part of **Task C6c**. However, the stratigraphy associated with these interconnected(?), coeval(?)

drainage systems remains unexplained, because the number and length of the subsurface samples are as yet insufficient to unravel their stratigraphic complexity.

IMPACT/APPLICATIONS

The seismic coverage generated by STRATAFORM has been an important part of the Mid-Atlantic Sea Level Transect, whose long-term goal has been to understand the effects of global changes of sea level, among other forcing factors, on the formation and preservation of stratigraphy over the past ~35 Ma. The sampling being undertaken as part of this grant will eventually provide the high-resolution ground truth necessary to look in detail at the latest Pleistocene-Holocene part of the eustatic record, tie it systematically to litho- and biofacies beneath the New Jersey mid- and outer shelf, and calibrate the shallow subsurface seismic stratigraphy that has been (Duncan et al., 2000) and is being developed for this margin.

TRANSITIONS

Long coring may take place, either in summer 2001 or later. We have begun discussions with Continental Scientific Drilling Program (DOSECC) personnel to use a modified version of the GLAD-800 barge-mounted drilling system as another possible means of achieving systematic subsurface control off New Jersey. Such cores, many of which will be collected within previous Huntec 2D/3D coverage, should eventually provide the ground truth in support of a new ONR research initiative off New Jersey, "Geoclutter."

RELATED PROJECTS

STRATAFORM and ODP (an international program funded through NSF) have both played prominent roles in ongoing New Jersey research. STRATAFORM and Geoclutter sampling envisioned for 2001 and beyond should proceed in tandem with additional acoustic reconnaissance, including 2D and 3D chirp sonar imaging, planned for 2001 and beyond as part of Geoclutter.

PUBLICATIONS

Austin, J. A., Jr., N. Christie-Blick, and M. Malone, 1998, Proc. ODP, Init. Repts., 174A. College Station, TX (Ocean Drilling Program; http://www-odp.tamu.edu/publications).

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Duncan, C. S., J. A. Goff, J. A. Austin, Jr., and C. S. Fulthorpe, 2000, Tracking the last sea-level cycle: seafloor morphology and shallow stratigraphy of the latest Quaternary New Jersey middle continental shelf. Marine Geology, v. 170, p. 395-421.

Fulthorpe, C. S., J. A. Austin, Jr., and G. S. Mountain, 1999, Buried fluvial channels off New Jersey: Did sea-level lowstands expose the entire shelf during the Miocene? Geology, v. 27, no. 3, p. 203-206.

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14. ABSTRACT

UTIG is integrating "nested" seismic data off New Jersey with subsurface samples, as they become available. This STRATAFORM goal is elusive, because "ground-truthing" of seismic sequence boundaries and intervening facies by sampling at relevant depths is incomplete. Objectives remain: 1) to study sea-level changes over the past ~35 Ma, and 2) to determine the effects of depositional and erosional processes on the preserved sediment record, from the seafloor to subbottom depths of ~100 m. A comprehensive characterization of the uppermost middle-outer New Jersey shelf is underway, building upon multibeam backscatter/bathymetric seafloor images and 2D/3D ultra-high resolution geophysical control. Results from ODP Leg 174A (1997) are published (see http://www-odp.tamu.edu/publications/). Since UTIG collected 3D Huntec data on the New Jersey shelf (1989), the primary continuing activity has been ground-truthing surficial images. Short piston cores were acquired after the 1989 survey; short vibra-cores were collected in association with a second 3D survey in 1993; long coring is now being pursued as part of Geoclutter.

15. SUBJECT TERMS

STRATAFORM, Geoclutter. continental terrace sedimentation and preservation, multibeam bathymetry, seafloor backscatter, sea level changes

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